Physics

Studying physics gives students the opportunity to understand and explain the world around them. Physics won't provide all the answers, but it will teach students how to ask the right questions and to develop a curiosity about how things work.

A good physicist can solve problems logically, apply reasoning, work both in a team and independently and can communicate their ideas clearly. Our physics students will benefit from developing these skills which last a lifetime, and which are highly valued by employers and for further education.

The Physics Story, Years 7-11

Physics tells us how a small number of very big ideas can explain almost everything in the universe. Students begin by learning about these ideas in a way that links to, and describes, their day-to-day, lived experience. They then consider these ideas in a more abstract way, learning that they apply to most of the universe, from the unimaginably small to the unimaginably large. Finally, they learn about the practical applications of these ideas, discovering the key role an understanding of physics plays in improving the quality of life for humanity.

The first big idea students encounter is that changing the movement of an object requires a net force to be acting upon it, which they learn through study of the forces they encounter every day. Learning about waves, by studying light and sound, introduces the idea that objects can affect other objects at a distance whilst remaining in the realm of children's experience. A study of energy transfer allows students to learn that the total amount of energy is always the same but can be transferred from one store to another during an event. Students also examine how energy is being produced in the UK and its sustainability for the future.

Students begin to abstract these ideas from their day-to-day experience through an in-depth study of electricity, developing their problem solving and analytical skills as they build, investigate and model circuits. Studying space and atomic theory shows that the laws of physics apply on every scale imaginable, and introduces two further big ideas: that all matter in the Universe is made of very small particles, and that our solar system is a very small part of one of billions of galaxies in the Universe.

Students move onto look at the application of these big ideas, allowing them to revisit and deepen their understanding of them through a wide range of practical opportunities. At the same time, they develop and refine their mathematical skills, using equations to model them in theoretical terms. They begin this with a study of energy resources and electricity, now able to apply their understanding of atomic theory to the latter. They revisit forces, and their application through a study of motion and the laws that describe it, before turning to waves and their use in detection and exploration. Finally, they return to the idea of forces at a distance by studying magnetic fields and the creation and uses of electromagnets.

Programme of study

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Year 7	Forces		Sound		Light	
Year 8	Light		Energy transfers		Electricity	
Year 9	Practical skills; radioactivity	States of matter	Energy transfer by heating	Molecules and matter	Energy resources	Intervention and challenge
Year 10	Electricity	Molecules and matter	Radioactivity	Forces in balance	Force and motion	Intervention and challenge
Year 11	Energy changes in systems	National and global energy resources	Electricity	Electromagnetism	Examination	

GCSE specification: AQA

Year 7 and 8 Physics fundamentals

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 7, Term 1: Forces	**Explain the difference between weight and mass.** • Explain how gravity affects weight and that it is measured in newtons. • Explain that mass is measured in g and kg and be able to convert between them. **Be able to use some standard units.** • Understand what SI units are, use them in the correct context and convert between them when applicable. *Please see bottom of the page for standard units and conversions.*	Weight, mass, grams, kilograms, time, length, pressure.
Year 7, Term 2: Sound	**Identify features on a wave** • Explain what happens to sounds waves when sound is increased or decreased in frequency • Identify waves from an oscilloscope • Identify waves from various images **Be able to draw a conclusion from an experiment** • Discuss how graphs can show a change in variable from an experiment. • Discuss line and scatter graphs and be able to interpret them. • Explain the relationship shown between variables on a graph that enable conclusions to be drawn. • Demonstrate how to draw a line of best fit •	Conclude, evaluate, data, evidence, wave, amplitude, peak, trough, frequency, wavelength
Year 7, Term 3: Light	**Draw a diagram to show refraction through a glass block** • Use a ray box and a glass block to track the change of direction in refraction and label it with the normal lines and angle of incidence. • Put arrows on the ray of light to show its direction. • Complete refraction diagrams by predicting the movement of light through a change in medium. **Draw an accurate ray diagram to show reflection** • Use a ray box and a plane mirror to show the reflection of light. • Represent the mirror as a dashed line. • Draw the normal and identify the angles of incidence and reflection on all diagrams. • Label the reflected and incidental ray. • Discover the relationship between the angle of incidence and the angle of reflection.	**Reflection,** absorb, continuous, incident, protractor, ray box, normal, relationship, convention, lenses, interface, converge, concave, convex, refraction, straight, opaque, absorbed, transmitted, cornea, retina, iris, pupil, optic nerve

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 8 term 1: Light	**Draw a diagram to show refraction through a glass block** • Use a ray box and a glass block to track the change of direction in refraction and label it with the normal lines and angle of incidence. • Put arrows on the ray of light to show its direction. • Complete refraction diagrams by predicting the movement of light through a change in medium. **Draw an accurate ray diagram to show reflection** • Use a ray box and a plane mirror to show the reflection of light. • Represent the mirror as a dashed line. • Draw the normal and identify the angles of incidence and reflection on all diagrams. • Label the reflected and incidental ray. Discover the relationship between the angle of incidence and the angle of reflection.	**Reflection,** absorb, continuous, incident, protractor, ray box, normal, relationship, convention, lenses, interface, converge, concave, convex, refraction, straight, opaque, absorbed, transmitted, cornea, retina, iris, pupil, optic nerve
Year 8 term 2: Energy transfers	**How are conduction and convection different?** • Explain how heat energy transfers to particles within substances and the effects of this • Investigate which metals conduct faster using melted wax and demonstrate convection using smoke chambers. • Use particle diagrams to show what happens when a metal is heated. • Use radiators as an example of convection and link to tectonic plates **To investigate how thickness of insulation affects energy transfer** • Identify examples of insulators and conductors. • Devise an experiment to test the insulating power of different materials and use a thermometer accurately, precisely and reliably to gather results. • Discuss the errors of the experiment.	Temperature, thermometer, heat, conductor, insulator, convection, conduction, energy, fluid, thermal, medium, particles, evaporate, radiation
Year 8 term 3: Electricity	**Be able to explain what current is in terms of flow of electrons** • Use models to explain current and illustrate circuits and discuss the benefits and drawbacks of the model. • Explain how current changes across a circuit both during a practical and from a written question. **Set up a simple series circuit and identify the components** • Draw circuit symbols and diagrams for series and parallel circuits, based on real circuits. • Explain how voltage and current change in a series and a parallel circuit and relate this to bulb bright ness.	Charge, current, electron, voltage, bulb, wire, crocodile clip, battery, cell, motor, amps, switch, ammeter, voltmeter, resistance, resistor

Year 9, 10 and 11 Physics fundamentals

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 9 autumn term: Radioactivity States of matter	• Can identify the nuclear model of an atom and state the locations of the protons, neutrons and electrons • Can name the three types of nuclear radiation nd rank them in terms of range and penetrating power • Can define half-life in simple terms and find it from a graph with support • Can describe the simple properties of solids, liquids and gases and name the changes of state • Can describe density as a property of a material and not a particular object and state that it is mass per unit volume • Can describe the processes of melting and boiling and say what state change occurs at the melting point and boiling point	
Year 9 spring term: energy transfer by heating	• Can describe the process of conduction and compare the thermal conductivities of different materials in simple terms • Can state that an object colls by emitting IR radiation energy is conserved in any transfer and heats by absorbing IR radiation • Can describe internal energy and specific latent heat	
Year 9 summer term:	• Can identify examples of renewable and non-renewable fuels • Can state some examples of renewable energy resources and state simple advantages and disadvantages of each system	

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 10 autumn term: Electricity Molecules and matter	• Can construct, draw and interpret simple circuits • Can state that resistance restricts the size of a current in a circuit and measure current and potential difference in a circuit to determine the resistance • Can identify series and parallel circuits and can collect potential difference and resistance in them • Can identify the key components of a three pin plug and socket and identify simple hazards in the wiring • Can state that electrical power of a devide is the amount of energy transferred by it per second • Can calculate energy transfer in joules and describe the factors that affect the cost of using an electrical device • Can describe the simple properties of solids, liquids and gases and name the changes of state • Can describe density as a property of a material and not a particular object and state that it is mass per unit volume • Can describe the processes of melting and boiling and say what state change occurs at the melting point and boiling point	

Year 10 spring term: Radioactivity Forces in balance	• Can identify the nuclear model of an atom and state the locations of the protons, neutrons and electrons • Can name the three types of nuclear radiation nd rank them in terms of range and penetrating power • Can define half-life in simple terms and find it from a graph with support • Can state what scalars and vextors are and give some examples • Can label a diagram showing showing various forces on an object • Can calculate a resultant force from two parallel forces acting in opposite directions	
Year 10 summer term: Forces in motion	• Can calculate speed and acceleration using the appropriate equations • Can interpret distance-time graphs to identify the speed • Can interpret velocity-time graphs to identify the acceleration and distance travelled • Can calculate force using the equation F = ma • Can state the difference between mass and weight • Can state what stopping distance is and list factors that will affect it	

Term and topic:	Fundamental knowledge	Entitlement vocabulary
Year 11 autumn term: Energy changes in systems Energy resources	• Can state some examples of energy stores and the processes that can transfer energy from one store to another • Can state that energy is conserved in any transfer • Can describe the process of conduction and compare the thermal conductivities of different materials in simple terms • Can state that an object cools by emitting IR radiation energy is conserved in any transfer and heats by absorbing IR radiation • Can identify examples of renewable and non-renewable fuels • Can state some examples of renewable energy resources and state simple advantages and disadvantages of each system •	
Year 11 spring term: Electricity and electromagnetism	• Can construct, draw and interpret simple circuits • Can state that resistance restricts the size of a current in a circuit and measure current and potential difference in a circuit to determine the resistance • Can identify series and parallel circuits and can collect potential difference and resistance in them • Can identify the key components of a three pin plug and socket and identify simple hazards in the wiring • Can state that electrical power of a devide is the amount of energy transferred by it per second • Can calculate energy transfer in joules and describe the factors that affect the cost of using an electrical device	

	• Can state the properties of magnetic materials • Can describe how to make an electromagnet and state the factors that affect its strength	
Year 11 summer term:	• Exams	

Forces SI Units:

Quantity	Unit name	Symbol
length	metre	m
area	metre squared	m^2
volume	metre cubed	m^3
mass	kilogram	kg
time	second	s
force	newton	N
pressure	pascal	Pa (1 Pa = 1 N/m^2)
energy	joule	J
speed	metres per second	m/s

Prefix	Symbol	Meaning	Example
mega-	M	1 000 000	1 megajoule (MJ) = 1 000 000 J
kilo-	k	1000	1 kilogram (kg) = 1000 g
deci-	d	$\frac{1}{10}$ (one tenth)	1 cubic decimetre (dm^3) = $\frac{1}{1000}$ m^3 ($\frac{1}{10}$ m × $\frac{1}{10}$ m × $\frac{1}{10}$ m)
centi-	c	$\frac{1}{100}$ (one hundredth)	100 centimetres (cm) = 1 m
milli-	m	$\frac{1}{1000}$ (one thousandth)	1000 milligrams (mg) = 1 g
micro-	μ	$\frac{1}{1\,000\,000}$ (one millionth)	1 000 000 micrometres (μm) = 1 m
nano-	n	$\frac{1}{1\,000\,000\,000}$	1 000 000 000 nanometres (nm) = 1 m